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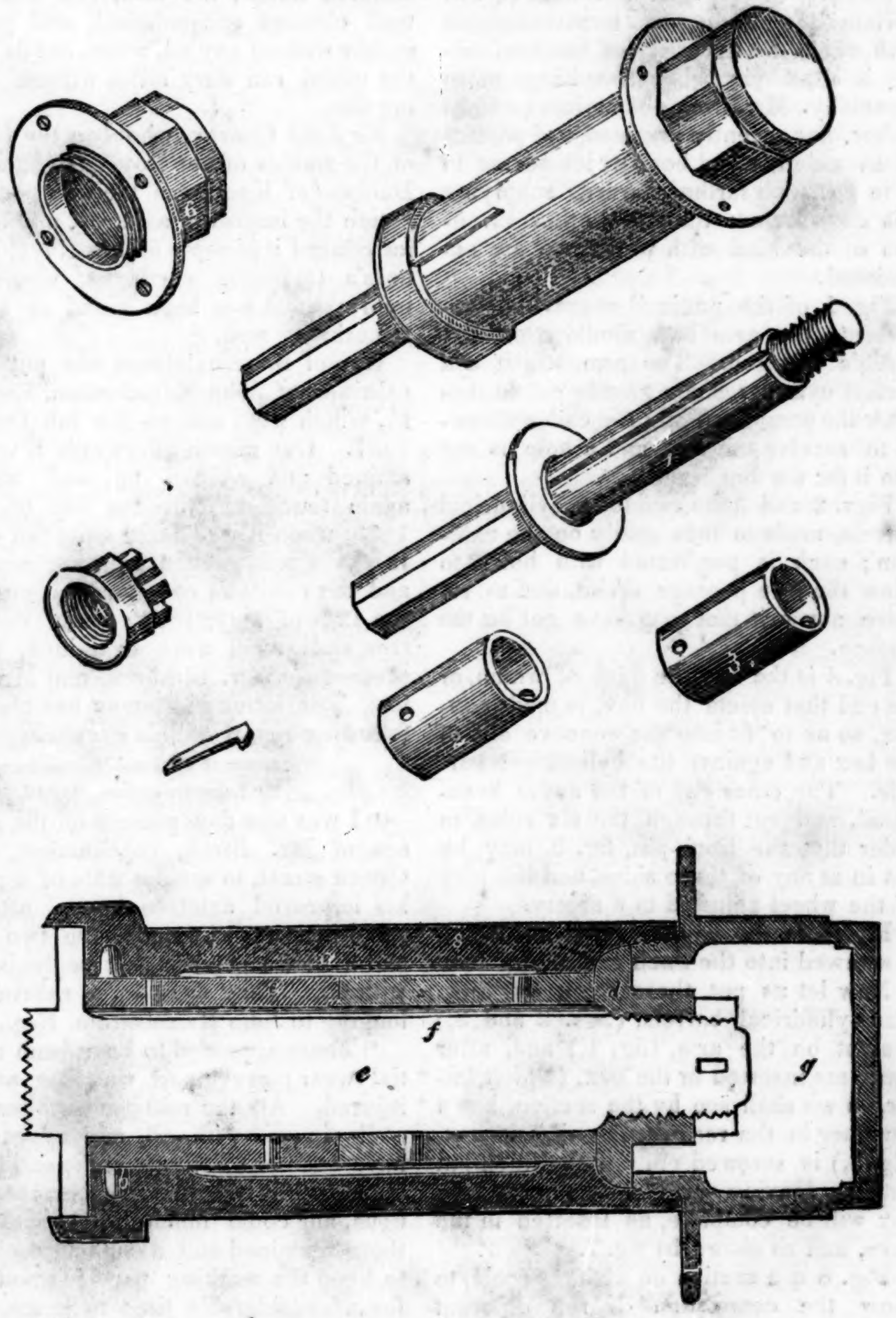
BIRCH'S PATENT AXLE-TREE AND BOX FOR CARRIAGES.



[From the London Mechanics' Magazine.]

Birch's Patent Axletree and Box for Carriages.

Many have been the attempts made to supply that important desideratum in coach-making, namely, a permanently oiled axle, or, to speak more properly, an axle that once supplied with a sufficiency of oil will remain so—if not forever, at least for such a length of time as will obviate the numerous inconveniences with which the necessity of frequent oiling is attended; when travelling, more especially. Mr. Birch, the eminent coachmaker, has recently invented and patented an axletree and box, which seems to us to go much farther towards supplying this desideratum than any other invention of the kind with which we are acquainted.

Fig. 1 of the prefixed engravings, represents the arm and shoulder of Mr. Birch's axletree. The arm, which is a perfect cylinder, has a groove cut in it to allow the passage of oil; the end is screwed to receive the nut, and a hole is cut into it for the linch-pin.

Figs. 2 and 3 are two loose cylindrical barrels, made to turn easily on the axle-arm; each is perforated with holes, to allow the free passage of oil, and to receive any grit that may have got on the surface.

Fig. 4 is the nut, the back of which, or the end that meets the box, is made convex, so as to fit into the concave end of the box and against the cylindrical barrels. The other end of the nut is hexagonal, and cut through the six sides, in order that the linch-pin, fig. 5, may be put in at any of these sides, and the play of the wheel adjusted to a nicety.

Fig. 6 is the cap or reservoir which is screwed into the linch end of the box.

Now let us put these parts together. The cylindrical barrels, (figs. 2 and 3,) are put on the arm, (fig. 1,) and, after these are inserted in the box, (which latter, as we shall see by the section, has a chamber in the rear for the oil,) the nut, (fig. 4,) is screwed on, and the linch-pin put in. Having screwed on the cap, the box will be complete, as inserted in the nave, and as shown by fig. 7.

Fig. 8 is a section on a larger scale, to show the connection of the different parts: *a a* is the box which shows the channels for the oil; *b b* the chamber to receive the oil; *c c* the cylindrical barrels; *d d* the nut; *e* the axle arm, showing the channel *f*; and *g* the cap.

Mr. Birch had fitted up a gig with one of these axletrees, one wheel of which being once oiled, was never again disturbed until worn out. The other wheel had the cap taken from it, and ran six hundred miles; the arm, &c. was then well cleaned and polished, and put together without any oil, when, in this state, the wheel ran sixty miles without sticking fast.

Sir John Conroy, who has the charge of the stables of her Royal Highness the Duchess of Kent, was the first person to notice the improved axletree, and he has introduced it in some of her Royal Highness's travelling carriages, where the improvement has been found to answer remarkably well.

One of these axletrees was put to the cabriolet of John Ramsbottom, Esq., M. P., which went out on the 9th October, 1831. One month afterwards it was examined and refitted up, and was not again touched until the 23d of May, 1833, when it was found quite full of oil. It was again refitted with the same oil, and the cabriolet continued in use until the 12th of May, 1834; when the axletree and wheel were examined, in the presence of Dr. Birkbeck and Mr. Toplis. The latter gentleman has made the following report of this examination:

"Museum of National Manufactures, &c.
"Leicester square, May 12, 1834.

"I was this day present on the premises of Mr. Birch, coachmaker, Great Queen street, to see the state of a pair of his improved axletree boxes, after the same had been in use above two years and a half since the last replenishment with oil. They were in a cabriolet belonging to John Ramsbottom, Esq., M. P.

"There appeared to have been no partial wear; every part was free and uninjured. All the rubbing surfaces were well covered with oil, and appeared to have been at all times sufficiently lubricated. The oil had not become glutinous, nor could much have escaped, as there remained still a sufficient quantity to keep the working parts in good order for a considerable time to come. The oil was discolored by the iron, but had

no verdigris in it. The wheel was replaced without any further supply of oil.

(Signed) "CHARLES TOPLIS,
"Director of the Museum."

[For the Mechanics' Magazine.]

Dr. Nott's Coal Stoves, useful to Tanners.

It affords me pleasure to communicate to those engaged in the tannery business a method of heating their factories, which has hitherto been unknown; but, like many other discoveries, it may seem to be of little consequence, because any one would have come to the same result by applying the same means. For several years I have heated my dwelling house and tannery with anthracite coal, and burned the same in open grates. Being satisfied from my own observation that Dr. Nott's patent coal stoves were preferable to open grates, not only on account of saving coal, but because there is no danger of fire, and the heat may be regulated according to the weather with the greatest facility, this fall I purchased a supply of Lackawana coal; and thinking I would save the price of a stove in fuel, I purchased one, and put it in my factory, where I found that less than half the quantity of coal it required in an open grate to heat my room, would generate more heat. I can account for it in no other way than this: the draft of the stove may be stopped as soon as the coal is on fire; the air, instead of being forced up the chimney by the heat of the stove, is retained —consequently, the room, when once heated, continues warm a great while. The reason a grate burns more coal than a stove is, I apprehend, because the draft of the former is the strongest; all the air in a room will pass up the chimney in a few minutes, when the grate or stove in the same is very hot, and has a strong draft. As fast as the heated air leaves the room, cold air enters it; when the draft of the stove is no greater than to emit the smoke and gas of the coal, very little air leaves the room; the heat is therefore uniform; and when sufficient heat is once acquired, it may be kept up with a very little fire in the stove. After burning coal a while, I thought tan might be used in my stove to great advantage: I tried the experiment, and was better pleased with this kind of fuel than with the coal. It kindles sooner and burns free; and it is no more trouble to put the same in the stove than coal. The stove need not be filled up many times in a day. It is no matter whether the tan is wet or dry: if two or three inches of dry tan or chips are first put in the stove, it dries as fast as it burns. I have a coal-scuttle which holds enough tan to fill my stove. I keep my tan under cover, and next year I intend to put the same in my wood-house as soon as it is thrown out of the vats, so that it will be perfectly dry when I want to use it. I have purchased another stove for my dwelling house, which I heat with tan. I consider a load of tan worth more than the same quantity of wood. What I formerly threw away, now affords me fuel. In justice, however, to the inventor of these stoves, I must acknowledge that I have since been informed that he has long known the value of tan, and that it could be burned to great advantage in his stoves, and used in generating heat for various purposes. It is to be hoped that Dr. Nott will make these discoveries known in future, for although they may seem to be of little importance to him, I can assure him that the above is of great value to me.

J. S.

[From the Repertory of Patent Inventions.]

Report on the Progress and Present State of our Knowledge of Hydraulics as a Branch of Engineering. By GEORGE RENNIE, Esq., F. R. S., &c. &c. Part I.

The Report of which the following is a part, has appeared in the recently published "Report of the Third Meeting of the British Association for the Advancement of Science; held at Cambridge in 1833." We purpose to present our readers with the whole of Mr. Rennie's review of the history of hydraulics, as applied to engineering, in successive extracts.

The paper now communicated to the British Association for the Advancement of Science, comprises a Report on the progress and present state of our knowledge of hydraulics as a branch of engineering, with reference to the principles already established on that subject.

Technically speaking, the term hydraulics signifies that branch of the science of hydrodynamics which treats of the motion of fluids issuing from orifices and tubes in reservoirs, o moving in pipes, canals, or rivers, osci ating in waves, or opposing a

resistance to the progress of solid bodies at rest.

We can readily imagine that if a hole of given dimensions be pierced in the sides or bottom of a vessel kept constantly full, the expenditure ought to be measured by the amplitude of the opening, and the height of the liquid column.

If we isolate the column above the orifice by a tube, it appears evident that the fluid will fall freely, and follow the laws of gravity. But experiment proves that this is not exactly the case, on account of the resistances and forces which act in a contrary direction, and destroy part of, or the whole, effect. The developement of these forces is so extremely complicated that it becomes necessary to adopt some auxiliary hypothesis or abbreviation in order to obtain approximate results. Hence the science of hydrodynamics is entirely indebted to experiment. The fundamental problem of it is to determine the efflux of a vein of water or any other fluid issuing from an aperture made in the sides or bottom of a vessel kept constantly full, or allowed to empty itself. Torricelli had demonstrated that, abstracting the resistances, the velocities of fluids issuing from very small orifices followed the subduplicate ratio of the pressures. This law had been, in a measure, confused by subsequent writers, in consequence of the discrepancies which appeared to exist between the theory and experiment, until Varignon remarked, that when water escaped from a small opening made in the bottom of a cylindrical vessel, there appeared to be very little, or scarcely any, sensible motion in the particles of the water; from which he concluded that the law of acceleration existed, and that the particles which escaped at every instant of time received their motion simply from the pressure produced by the weight of the fluid column above the orifice; and that the quantity of motion or expenditure is in the ratio of the breadth of the orifice, multiplied by the square of the velocity, or, in other words, that the height of the water in the vessel is proportional to the square of the velocity with which it escapes; which is precisely the theorem of Torricelli. This mode of reasoning is in some degree vague, because it supposes that the small mass which escapes from the vessel at each instant of time acquires its velocity from the pressure of the column immediately above the orifice. But supposing, as is natural, that the weight of the column acts on the particle during the time it takes to issue from the vessel, it is clear that this particle will receive an accelerated motion, whose quantity in a given time will be proportional to the pressure multiplied by the time: hence the product of the weight of the column by the time of its issuing from the orifice, will be equal to the product of the mass of this particle by the velocity it will have acquired; and as the mass is the product of the opening of the orifice, by the small space which the particle describes in issuing from the orifice, it follows that the height of the column will be as the square of the velocity acquired. This theory is the more correct the more the fluid approaches to a perfect state of repose, and the more the dimensions of the vessel exceed the dimensions of the orifice. By a contrary mode of reasoning, this theory became insufficient to determine the motions of fluids through pipes of small diameters. It is necessary, therefore, to consider all the motions of the particles of fluids, and examine how they are changed and altered by the figure of the conduit. But experiment teaches us that when a pipe has a different direction from the vertical one, the different horizontal sections of the fluid preserve their parallelism, the sections following taking the place of the preceding ones, and so on; from which it follows, (on account of the [sensible] incompressibility of the fluid,) that the velocity of each horizontal section or plate, taken vertically, ought to be in the inverse ratio of the diameter of the section. It suffices, therefore, to determine the motion of a single section, and the problem then becomes analogous to the vibration of a compound pendulum, by which, according to the theory of James Bernoulli, the motions acquired and lost at each instant of time form an equilibrium, as may be supposed to take place with the different sections of a fluid in a pipe, each section being animated with velocities acquired and lost at every instant of time.

The theory of Bernoulli had not been proposed by him until long after the discovery of the indirect principle of *vis viva* by Huygens. The same was the case with the problem of the motions of fluids issuing from vessels, and it is surprising that no advantage had been taken of it earlier. Michelloti, in his experimental researches, *de Separatione Fluidorum in Corpore Animali*, in rejecting the theory of the Newtonian cataract, (which had been advanced in Newton's Mathematical Principles, in the year 1687, but afterwards corrected in the year 1714,) supposes the water to escape from an orifice in the bottom of a vessel kept constantly full, with a velocity produced by the height of the superior surface; and that if, immediately above the lowest plate of water escaping from the orifice, the column of water be frozen, the weight of the column will have no effect on the velocity of the water issuing from the orifice; and that if this solid column be at once changed to its liquid state, the effect will remain the same. The Marquis Poleni, in his work *De Cas-*

tellis per quæ derivantur Fluviorum Aquæ, published at Padua, in the year 1718, shows from many experiments, that if A be the orifice, and H the height of the column above it, the quantity of water which issues in a given time is represented by $2\ A\ H \times \frac{0{\cdot}571}{1{\cdot}000}$, whereas, if it spouted out from the orifice with a velocity acquired by falling from the height H, it ought to be exactly 2 A H, so that experiment only gives a little more than half the quantity promised by the theory; hence, if we were to calculate from these experiments the velocity that the water ought to have to furnish the necessary quantity, we should find that it would hardly make it re-ascend one third of its height. These experiments would have been quite contrary to expectation, had not Sir Isaac Newton observed that water issuing from an orifice $\frac{5}{8}$ths of an inch in diameter was contracted $\frac{21}{25}$ of the diameter of the orifice, so that the cylinder of water which actually issued was less than it ought to have been, according to the theory, in the ratio of 441 to 625; and augmenting it in this proportion, the opening should have been $2\ A\ H\ \frac{0{\cdot}805}{1{\cdot}000}$, or $\frac{4}{5}$ths of the quantity which ought to have issued on the supposition that the velocity was in the ratio of the square root of the height; from which it was inferred that the theory was correct, but that the discrepancy was owing to certain resistances, which experiment could alone determine. The accuracy of the general conclusion was affected by several assumptions, namely, the perfect fluidity and sensibility of the mass, which was neither affected by friction nor cohesion, and an infinitely small thickness in the edge of the aperture.

Daniel Bernoulli, in his great work, *Hydrodynamica, seu de Viribus et Motibus Fluidorum Commentaria*, published at Strasburg in the year 1738, in considering the efflux of water from an orifice in the bottom of a vessel, conceives the fluid to be divided into an infinite number of horizontal strata, on the following suppositions, namely, that the upper surface of the fluid always preserves its horizontality; that the fluid forms a continuous mass; that the velocities vary by insensible gradations, like those of heavy bodies; and that every point of the same stratum descends vertically with the same velocity, which is inversely proportional to the area of the base of the stratum; that all sections thus retaining their parallelism are contiguous, and change their velocities imperceptibly; and that there is always an equality between the vertical descent and ascent, or *vis viva:* hence he arrives, by a very simple and elegant process, to the equations of the problem, and applies its general formulæ to several cases of practical utility. When the figure of the vessel is not subject to the law of continuity, or when sudden and finite changes take place in the velocities of the section, there is a loss of *vis viva*, and the equations require to be modified. John Bernoulli and Maclaurin arrived at the same conclusions by different steps, somewhat analogous to the cataract of Newton. The investigations of D'Alembert had been directed principally to the dynamics of solid bodies, until it occurred to him to apply them to fluids; but in following the steps of Bernoulli he discovered a formula applicable to the motions of fluids, and reducible to the ordinary laws of hydrostatics. The application of his theory to elastic and non-elastic bodies, and the determination of the motions of fluids in flexible pipes, together with his investigations relative to the resistance of pipes, place him high in the ranks of those who have contributed to the perfection of the science.

The celebrated Euler, to whom every branch of science owes such deep obligations, seems to have paid particular attention to the subject of hydrodynamics; and in attempting to reduce the whole of it to uniform and general formulæ, he exhibited a beautiful example of the application of analytical investigation to the solution of a great variety of problems for which he was so famous. The Memoirs of the Academy of Berlin, from the year 1768 to 1771, contain numerous papers relative to fluids flowing from orifices in vessels, and through pipes of constant or variable diameters. "But it is greatly to be regretted," says M. Prony, "that Euler had not treated of friction and cohesion, as his theory of the linear motion of air would have applied to the motions of fluids through pipes and conduits, had he not always reasoned on the hypothesis of mathematical fluidity independently of the resistances which modify it."

In the year 1765 a very complete work was published at Milan by Paul Lecchi, a celebrated Milanese engineer, entitled *Idrostatica esaminata ne' suoi Principi e Stabilite nelle suoi Regole della Mensura della Acque correnti*, containing a complete examination of all the different theories which had been proposed to explain the phenomena of effluent water, and the doctrine of the resistance of fluids. The author treats of the velocity and quantity of water, whether absolutely or relatively, which issues from orifices in vessels and reservoirs, according to their different altitudes, and inquires how far the law applies to masses of water flowing in canals and rivers, the velocities and quantities of which he gives the methods of

measuring. The *extensive and successful practice* of Lecchi as an engineer added much to the reputation of his work."

In the year 1764, Professor Michelotti, of Turin, undertook, at the expense of the King of Sardinia, a very extensive series of experiments on running water, issuing orifices, and additional tubes placed at different heights in a tower of the finest masonry, twenty feet in height and three feet square inside. The water was supplied by a channel two feet in width, and under pressures of from five to twenty-two feet. The effluent waters were conveyed into a reservoir of ample area, by canals of brick-work lined with stucco, and having various forms and declivities; and the experiments, particularly on the efflux of water through differently shaped orifices, and additional tubes of different lengths, were most numerous and accurate; and Michelotti was the first who gave representations of the changes which take place in the figure of the fluid vein, after it has issued from the orifice. His experiments on the velocities of rivers, by means of the bent tube of Pitot, and by an instrument resembling a water-wheel, called the *stadera idraulica*, are numerous and interesting; but, unfortunately, their reduction is complicated with such various circumstances, that it is difficult to derive from them any satisfactory conclusions. But Michelotti is justly entitled to the merit of having made the greatest revolution in the science by experimental investigation.† The example of Michelotti gave a fresh stimulus to the exertions of the French philosophers, to whom, after the Italians, the science owes the greatest obligations. Accordingly, the Abbe Bossut, a most zealous and enlightened cultivator of hydrodynamics, undertook, at the expense of the French government, a most extensive and accurate series of experiments, which he published in the year 1771, and a more enlarged edition, in two volumes, in the year 1786, entitled *Traite Theorique et Experimental d' Hydrodynamique*. The first volume treats of the general principles of hydrostatics and hydraulics, including the pressure and equilibrium of non-elastic and elastic fluids against inflexible and flexible vessels; the thickness of pipes to resist the pressure of stagnant fluids; the rise of water in barometers and pumps, and the pressure and equilibrium of floating bodies: the general principles of the motions of fluids through orifices of different shapes, and their friction and resistance against the orifices; the oscillations of water in syphons; the percussion and resistance of fluids against solids; and machines moved by the action and re-action of water. The second volume gives a great variety of experiments on the motions of water through orifices and pipes and fountains; their resistance in rectangular or curvilinear channels, and against solids moving through them; and, lastly, of the fire—or steam-engine. In the course of these experiments, he found that when the water flowed through an orifice in a thin plate, the contraction of the fluid vein diminished the discharge in the ratio of 16 to 10; and when the fluid was discharged through an additional tube, two or three inches in length, the theoretical discharge was diminished only in the ratio of 16 to 13. In examining the effects of friction, Bossut found that small orifices discharged less water in proportion than large ones, on account of friction, and that, as the height of the reservoir augmented, the fluid vein contracted likewise; and by combining these two circumstances together, he has furnished the means of measuring with precision the quantity of water discharged either from simple orifices or additional tubes, whether the vessels be constantly full, or be allowed to empty themselves. He endeavored to point out the law by which the diminution of expenditure takes place, according to the increase in the length of the pipe or the number of its bends; he examined the effect of friction in diminishing the velocity of a stream in rectangular and curvilinear channels; and showed that in an open canal, with the same height of reservoir, the same quantity of water is always discharged, whatever be the declivity and length; that the velocities of the waters in the canal are not as the square roots of the declivities; and that in equal declivities and depth of the canal the velocities are not exactly as the quantities of water discharged; and he considers the variations which take place in the velocity and level of the waters, when two rivers unite, and the manner in which they establish their beds.

His experiments, in conjunction with D'Alembert and Condorcet, on the resistance of fluids, in the 1777, and his subsequent application of them to all kinds of surfaces, including the shock and resistance of water wheels, have justly entitled him to the gratitude of posterity. The Abbe Bossut had opened out a new career of experiments; but the most difficult and important problem remaining to be solved related to rivers. It was easy to perform experiments with water running through pipes and conduits on a small scale, under given and determined circumstances: but when the mass or fluid rolled in channels of unequal capacities, and which were composed of every kind of material, from the rocks amongst which it accumulated to the gravel

* See also Memoire Idrostatico-storiche, 1773.

† Sperimenti Idraulici, 1767 and 1771.

and sand through which it forces a passage,—at first a rapid and impetuous torrent, but latterly holding a calm and majestic course,—sometimes forming sand-banks and islands, at other times destroying them,—at all times capricious, and subject to variation in its force and direction by the slightest obstacles,—it appeared impossible to submit them to any general law.

Unappalled, however, by these difficulties, the Chevalier Buat, after perusing attentively M. Bossut's work, undertook to solve them by means of a theorem which appeared to him to be the key of the whole science of hydraulics. He considered that if water was in a perfect state of fluidity, and ran in a bed from which it experienced no resistance whatever, its motion would be constantly accelerated, like the motion of a heavy body descending an inclined plane—but as the velocity of a river is not accelerated *ad infinitum*, but arrives at a state of uniformity, it follows that there exists some obstacle which destroys the accelerating force, and prevents it from impressing upon the water a new degree of velocity. This obstacle must therefore be owing either to the viscidity of the water, or to the resistance it experiences against the bed of the river; from which Dubuat derives the following principle. That when water runs uniformly in any channel, the accelerating force which obliges it to run is equal to the sum of all the resistances which it experiences, whether arising from the viscidity of the water or the friction of its beds. Encouraged by this discovery, and by the application of its principles to the solution of a great many cases in practice, Dubuat was convinced that the motion of water in a conduit pipe was analogous to the uniform motion of a river, since in both cases gravity was the cause of motion, and the resistance of the channel or perimeter of the pipes the modifiers. He then availed himself of the experiments of Bossut on conduit pipes and artificial channels to explain his theory: the results of which investigations were published in the year 1779. M. Dubuat was, however, sensible that a theory of so much novelty, and at variance with the then received theory, required to be supported by experiments more numerous and direct than those formerly undertaken, as he was constrained to suppose that the friction of the water did not depend upon the pressure, but on the surface and square of the velocity. Accordingly, he devoted three years to making experiments, and with ample funds and assistance provided by the French government, was enabled to publish his great work, entitled *Principes d' Hydraulique verifies par un grand nombre d' Experiences, faites par Ordre du Governement,* 2 vols. 1786, (a third volume, entitled *Principes d' Hydraulique et Hydrodynamique*, appeared in 1816); in the first instance, by repeating and enlarging the scale of Bossut's experiments on pipes, (with water running in them,) of different inclinations or angles, of from 90° to $\frac{1}{400000}$th part of a right angle, and in channels of from $\frac{1}{2}$ line in diameter to 7 and 8 square toises of surface, and subsequently to water running in open channels, in which he experienced great difficulties in rendering the motion uniform; but he was amply recompensed by the results he obtained on the diminution of the velocity of the different parts of a uniform current, and of the relation of the velocities at the surface and bottom, by which the water works its own channel, and by the knowledge of the resistances which different kinds of beds produce, such as clay, sand, and gravel; and varying the experiments on the effect of sluices, and the piers of bridges, &c., he was enabled to obtain a formula applicable to most cases in practice.*

Thus let V = mean velocity per second, in inches;

d = hydraulic mean depth, or quotient, which arises from dividing the area or section of the canal in square inches, by the perimeter of the part in contact with the water, in linear inches;

s = the slope or declivity of the pipe, or the surface of the water;

g = 16·087, the velocity in inches which a body acquires in falling one second of time;

n = an abstract number, which was found by experiment to be equal to 243·7;

$$\text{Then } v = \frac{\sqrt{ng}\,(\sqrt{d} - 0{\cdot}1)}{\sqrt{s} - \log.\sqrt{s} + 1{\cdot}6} - 0{\cdot}3\,(\sqrt{d} - 0.1)$$

Such are the objects of M. Dubuat's work. But his hypotheses are unfortunately founded upon assumptions which render the applications of his theory of little use. It is evident that the supposition of a constant and uniform velocity in rivers cannot hold: nevertheless, he has rendered great services to the science by the solution of many important questions relating to it; and although he has left on some points a vast field open to research, he is justly entitled to the merit of originality and accuracy.

Contemporary with Dubuat was M. Chezy, one of the most skilful engineers of his time: he was director of the Ecole des Ponts et Chaussees, and reported, conjoint-

* Edinburgh Encyclopædia, art. Hydrodynamics, by Brewster.

ly with M. Perronet, on the Canal Yvette. He endeavored to assign, by experiment, the relation existing between the inclination, length, transverse section, and velocity of a canal. In the course of this investigation he obtained a very simple expression of the velocity, involving three different variable quantities, and capable, by means of a single experiment, of being applied to all currents whatever. He assimilates the resistance of the sides and bottom of the canal to known resistances, which follow the law of the square of the velocity, and he obtains the following simple formula:

$v = \frac{\sqrt{g\,d}}{z\,s}$, where g is $= 16{\cdot}087$ feet, the heavy body after falling one second;

$d =$ hydraulic mean depth, equal to the area of the section divided by the perimeter of the part of the canal in contact with the water;

$s =$ the slope or declivity of the pipe;

$z =$ an abstract number, to be determined by experiment.

In the year 1784, M. Lespinasse published in the Memoirs of the Academy of Science at Toulouse two papers, containing some interesting observations on the expenditure of water through large orifices, and on the junction and separation of rivers. The author had performed the experiments contained in his last paper on the rivers Fresquel and Aude, and on that part of the canal of Languedoc below the Fresquel lock, towards its junction with that river.

As we before stated, M. Dubuat had classified with much sagacity his observations on the different kinds of resistance experienced in the motion of fluids, and which might have led him to express the sum of the resistances by a rational function of the velocity composed of two or three terms only. Yet the merit of this determination was reserved to M. Coulomb, who, in a beautiful paper, entitled "Experiences destinees a determiner la Coherence des Fluides et les Lois de leurs Resistances dans les Mouvemens tres lents," proves, by reasoning and facts,

1st. That in extremely slow motions the part of the resistance is proportional to the square of the velocity;

2dly. That the resistance is not sensibly increased by increasing the height of the fluid above the resisting body;

3dly. That the resistance arises solely from the mutual cohesion of the fluid particles, and not from their adhesion to the body upon which they act;

4thly. That the resistance in clarified oil, at the temperature of 69° Fahrenheit, is to that of water as $17{\cdot}5 : 1$; a proportion which expresses the ratio of the mutual cohesion of the particles of oil to the mutual cohesion of the particles of water.

M. Coulomb concludes his experiments by ascertaining the resistance experienced by cylinders that move very slowly and perpendicularly to their axes, &c.

This eminent philosopher, who had applied the doctrine of tension with such distinguished success in investigating the phenomena of electricity and magnetism, entertained the idea of examining in a similar manner the resistance of fluids, contrary to the doctrines of resistance previously laid down. M. Coulomb proved, that in the resistance of fluids against solids, there was no constant quantity of sufficient magnitude to be detected; and that the pressure sustained by a moving body is represented by two terms, one which varies as the simple velocity, and the other with its square.

The apparatus with which these results were obtained consisted of discs of various sizes, which were fixed to the lower extremity of a brass wire, and were made to oscillate under a fluid by the force of tension of the wire. By observing the successive diminution of the oscillations, the law of resistance was easily found. The oscillations which were best suited to these experiments continued for twenty or thirty seconds, and the amplitude of the oscillation (that gave the most regular results) was between 480, the entire division of the disc, and 8 or 10 divisions from zero.

The first who had the happy idea of applying the law of Coulomb to the case of the velocities of water running in natural or artificial channels, was M. Girard, Ingenieur en Chef des Ponts et Chaussees, and Director of the works of the Canal l'Ourcq at Paris.*

He is the author of several papers on the theory of running waters, and of a valuable series of experiments on the motions of fluids in capillary tubes.

M. Coulomb had given a common co-efficient to the two terms of his formula, representing the resistance of a fluid,—one proportional to the simple velocity, the other to the square of the velocity. M. Girard found that this identity of the co-efficients was applicable only to particular fluids under certain circumstances; and his conclusions were confirmed by the researches of M. Prony, derived from a great many experiments, which make the co-efficients not only different, but very inferior to the value of the motion of the filaments of the water contiguous to the side of the pipe.

[*To be continued.*]

* Essai sur le Mouvement des Eaux courantes: Paris: 1804. Recherches sur les Eaux publiques, &c. Devis general du Canal l' Ourcq, &c.

Specification of the Patent granted to ROBERT STEPHENSON *the Younger, for an Improvement in the Mode of Supporting the Iron Rails for Edge Railways.*—Sealed December 11, 1833.

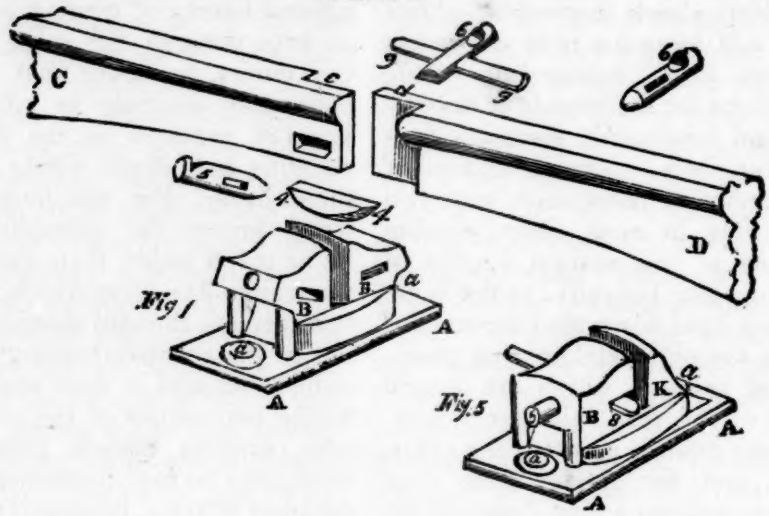
My said improvement in the mode of supporting the iron rails for edge railways relates to the construction of the chairs, or iron supports, in which the iron rails for edge railways are to be seated and fastened, and which chairs are to be firmly bedded and spiked down upon stone blocks, or upon wooden sleepers, or cross bearers, in the manner now usually practised for the ordinary chairs of edge railways; and the object of my said improvement is to provide firm and secure bearings at the bottoms of the notches in the chairs for the rails to rest upon, those bearings being capable of self-adjustment, in order that they may adapt themselves correctly to the under parts of the rails; and adequate provisions being also made for fastening the iron rails securely downwards upon such self-adjusting bearings, as well as for confining the rails laterally within the notches in the chairs, but in such manner that the said self-adjusting bearings will not be subject to be deranged, or the said fastenings to be loosened, by the effect of any such slight tilting or inclination of the chairs in the direction of the length of the rails as may result from partial or unequal subsidence of the ground beneath the stone blocks or wood sleepers, upon which the chairs are fastened, nor by the effect of any such slight elongations and contractions in the length of the rails as they are usually liable to from ordinary changes of temperature. And my said improvement consists in the application of a self-adjusting segmental bearing-piece into a suitable cell at the lower part or bottom of the notch in each chair, in order to form a bearing-surface for the rail to rest upon, the said segmental bearing-piece being in the form of a segment of a circle, and lodged with its convexity or circular arch of the segment downwards within the cell, which is of corresponding concavity, and excavated below the usual level of the bottom of the notch in the chair; the flat side or chord of the said segment being uppermost, and forming the bearing-surface at the bottom of the notch in the chair; upon that bearing-surface the underside of the iron rail is to rest, and the said bearing-surface will always accomodate itself to the said under side of the rail, so as to form an even contact therewith, in consequence of the lower convex part of the segmental bearing-piece assuming a suitable position within its cell, whereby the said uppermost or rail-bearing surface of the said segmental bearing-piece will always preserve its conformity to the under side of the rail, although the chair itself in which the said bearing-piece is applied should come to tilt or incline in the direction of the length of the rail, in consequence of unequal settlemont of the ground in which the stone block or the sleeper is bedded. And in order to fasten the rails securely downwards upon my said segmental bearing-pieces, as well as to confine the rails laterally within the notch of each of the chairs, the parts with which each chair is provided for the purpose of such fastening, must take its (or their) hold of the rail (or of the rails) at or very near to the centre of the circular curvature of the said segmental bearing-piece, and of the cell wherein the same is lodged, because a settlement or tilting of the chair, and the corresponding self-adjustment of the segmental bearing-piece in its cell, as aforesaid, will not have any material tendency to loosen or interfere with the holding-down action, when the same is applied at or very near to the centre, about which the motion attendant on the said adjustment will take place. And further, the said holding-down action, which is to be applied, as aforesaid, by taking hold of the rail or rails at or near to the said centre, must take that hold in such manner as will permit of slight elongation and contraction of the rail or rails, in the direction of their length, without relaxing the effort of the holding-down action, or displacing the point of action thereof away from the said centre. And likewise, the same parts which perform the holding-down must effect the lateral confinement of the rails within the notches of the chairs, and must also retain the rails edgeways upwards, in a proper position for the wheels of railway carriages or of locomotive steam engines to travel upon them. The mode of holding-down

and fastening the rails upon my said segmental bearing-pieces, which I recommend for the fulfilment of the aforesaid conditions, is by the application of cylindrical centre-pins of iron, which are fitted into corresponding sockets formed through the cheeks or sides of the notches of the chairs, so as to be firmly held in a horizontal direction, or nearly horizontal, and crossways to the direction of the length of the rails; and which cylindrical pins terminate with obtuse conical points at those ends which project from the sockets into the notches of the chairs, and the said points enter into oblong or grooved recesses, which are formed in the upright sides of the under part of the rails, suitably for the reception of the said points, the oblong elongation of the said grooved recesses being in a longitudinal direction along the rails; each of the said cylindrical pins is transfixed by a tapering or wedge-like key, which is inserted horizontally through a suitable mortice opening in the cheek or side of the chair, so as also to pass crossways through a suitable mortice opening across the cylindrical pin, at right angles to the length thereof, and in a direction parallel to the length of the iron rails. The said tapering key being so applied in its mortices through the cheek of the chair and through the cylindrical pin, that when the key is driven in through its mortices, the cylindrical pin will be forced forwards endways with its conical end or point in contact with the rail, in consequence of the tapering form of the wedge-like key; and the conical end of the cylindrical pin being by that means forced into the aforesaid grooved recess in the rail, that conical end will bear on the lower part of that recess, with an oblong bearing-down action, which will jamb the rail downwards upon its self-adjusting bearing-piece, at the same time that it confines the rail laterally within the notch of the chair. And, note—those chairs which are to receive and support the extremities of the several lengths of iron rails at the junction of those extremities, require to be provided with two of the aforesaid cylindrical pins and wedge keys, in each chair, namely, one cylindrical pin through each cheek or side of the notch in the chair, with the conical points of those pins directed towards each other. The extremities of the lengths of iron rails may be united by what are called scarf or half-lap joints, which apply flatwise to each other, side by side; and the double, or over-lapping parts, at the ends of two adjoining rails, being included within the notch in the same chair, the conical points of the two opposite pins of that chair are both to be forced forwards, by their respective wedge-like keys, into the grooved recesses aforesaid, which are made at the outside of each the two halves of the half-lap or scarf joint, by which means the pressure occasioned by the wedging up of the two pins will hold the said two halves firmly together, at the same time that the action of each of the conical points of the pins, within its own grooved recess in one half of the joint of the rails, will hold that half down upon my segmental bearing-piece, which is applied as aforesaid, in its cell, at the bottom of the notch in the chair, for the ends of the two rails to act upon, wherefore by the keying of the two opposite pins of the same chair the junction of two rails is made secure laterally; and also, the extremity of each of those two rails which form the junction is fastened downwards, independently of the fastening down of the extremity of its fellow rail, in the same chair, and on the same segmental bearing-piece at the bottom of the notch of that chair. But those chairs which are to form the intermediate supports for the several lengths of iron rails, between the junctions of those lengths, require only one of the said cylindrical pins in each chair, viz. through one of the sides or cheeks of the notch of the chair, the opposite side or cheek being a flat vertical surface (or nearly so) against which the flat vertical surface ot the iron rail is pressed laterally, and held firm thereto, by the keying up of the cylindrical pin through that cheek or side of the notch of the chair to which the said flat vertical surface is opposite; and at the same time, the action of the conical point of the cylindrical pin, in its grooved recess in the rail, holds the rail forcibly downwards upon my segmental bearing-piece, which is applied in its cell, as aforesaid, at the bottom of the notch of thec hair, for the under-side of the rail to rest upon. The said intermediate chairs, with one cylindrical pin in each chair, by

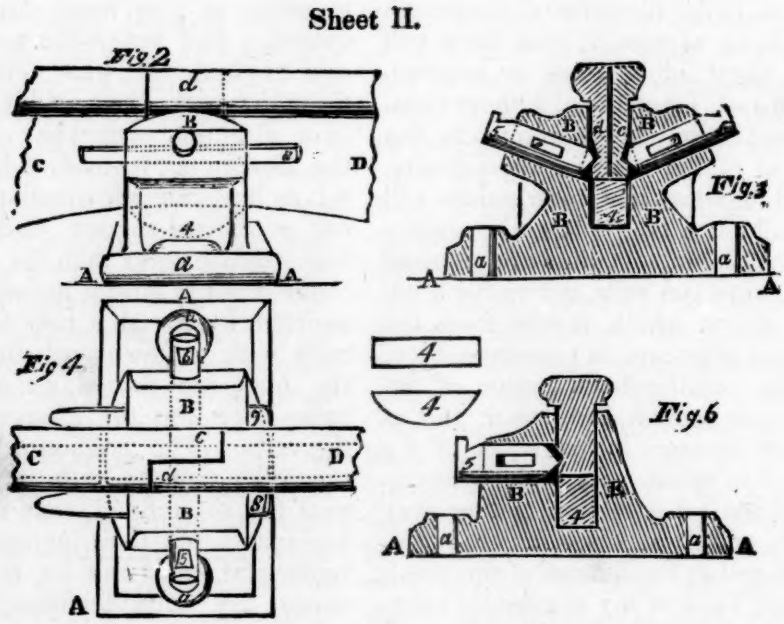
nolding the rails laterally against the flat vertical side or cheek thereof, as above mentioned, will keep the rails edgeways upwards, and firmly retained in their proper positions for the wheels of railway carriages and locomotive steam-engines to travel over them. The other kind of chairs hereinbefore mentioned, with two cylindrical pins in each chair, confine the junctions of the several lengths of iron rails together laterally, at the same time that they hold down the extremity of each rail on my segmental bearing-piece. The grooved recesses which are formed in the sides of the iron rails for the reception of the conical points of the cylindrical pins, and for giving them their oblique bearing-down action, being of an oblong form, in the direction of the length of the rails, as aforesaid, that form will permit of slight elongations or contractions of the rails lengthwise, without causing any relaxation or alteration in the confinement of the rails in their chairs, because elongations and contractions will have no influence on the lateral pressure which the said conical points are required to exert against the rails, nor on the holding-down action which results from the same lateral pressure, in consequence of the oblique bearing-down action of the conical points against the lower part of the grooved recesses in the sides of the rails. And in consequence of the centre of the said conical points being at or very near to the centre of the circular curvature of the cell at the bottom of the notch in the chair, (and of my segmental bearing-piece, which is lodged in that cell,) any slight tilting or inclination of the chair in the direction of the length of the rails and consequent self-adjustment of the said segmental bearing-piece in its cell, will not cause any relaxation of the confinement of the rails in their chairs, because such tilting will have no influence, either on the lateral action of the conical points, or on the holding-down action, which results therefrom, by oblique action of the said conical points in the grooved recesses in the rails. And note—in lieu of mere conical points to the said cylindrical pins, the latter may terminate with obtuse wedge-like or chissel ends, adapted to enter into and act obliquely within the aforesaid oblong grooved recesses in the rails, in which case the cylindrical pins must be allowed a small liberty of turning motion in their sockets, through the sides or cheeks of the chairs, in order that their chissel ends may continue to conform to the grooved recesses in the rails, notwithstanding any slight tilting of the chairs themselves. For this purpose the mortices through the cylindrical pins must be as much wider than the thickness of the wedge-like keys which are to be driven through the said mortices as will permit of the requisite turning motion of the cylindrical pins in their sockets. And the acting extremities of the said cylindrical pins, whether conical points or chissel ends, may be case-hardened, or they may be made of steel, hardened and tempered, in order to give them durability if required. And note—the sockets for the said cylindrical pins may be made through the cheeks or sides of the chairs, in a direction somewhat inclining from the horizontal, instead of being horizontal, as hereinbefore mentioned, the conical or chissel-shaped ends of the pins being rather lower than the other ends, in order that the lateral action and pressure exerted by the pins may act against the rails with a downwards tendency, when the pins are forced endways by their cross-keys into the grooved recesses in the rails. The holding-down action on the rails will be rather greater if the pins are so inclined, than if the pins are horizontal, but their inclination from the horizontal must not be so great as to cause any sensible impediment to the turning action, which the conical points of the pins must make within the grooved recesses in the rails, or else the turning motion which the chissel-ended pins must make in their sockets, in order to accommodate to a tilting inclination of the chairs. And for the more complete explanation of the manner of carrying my said improvement into effect, I have hereunto annexed two sheets of drawings, which exhibit two chairs for supporting the iron rails of edge railways, when the same are constructed according to my said improvement.

Fig. 1, in sheet I., is a perspective view; and in sheet II., fig. 2 is a lateral elevation; fig. 3, a transverse section; and fig. 4, a horizontal plan of a chair, for supporting and uniting the extremities of

Sheet I.



Sheet II.



the lengths of iron rails for edge railways. A, A, is the flat bottom or base of the chair, which is to be bedded upon the stone block, or wooden sleeper, and firmly fastened thereto by spikes driven down through the holes, *a, a.* B, B, are the cheeks or sides of the notch in the chair, that notch being the parallel space which is left between the said cheeks or sides for the reception of the rails C, *c*, D, *d*, which may join together with a half-lap joint, as is shown in the perspective view, fig. 1, and in the plan, fig. 4, the double or overlapping parts, *c, d,* being of the same size, or nearly of the same size, as the other parts of the rails, and those parts are included within the notch of the chair. The bottom of the said notch is deeper than necessary for receiving the rails, and is depressed into a concavity or cell suitable for the reception of my segmental bearing-piece, 4; see also fig. 1, where the same is represented separately; the under edges of the rails rest upon the uppermost flat surface of the said bearing-piece, 4, the undermost part of which is a circular curve, and the form of the cell corresponds thereto. 5 and 6, are the cylindrical pins, which are fitted into cylindrical sockets, through each of the cheeks or sides. B, B, and 8, 9, are the tapering or wedge-like keys, which are inserted through suitable mortices in the cheeks, and across the pins 5 and 6, for the purpose of forcing forward those pins, so that their pointed extremities may

press obliquely upon the lower parts of the grooved recesses in the rails, with a bearing-down action, which will confine the rails downwards upon the bearing-piece, 5, at the same time that they are confined laterally in the chair. The cylindrical pins, represented in figs. 1, 2, 3, and 4, are in an inclined direction, in order that their bearing-down action may be more efficient, but the pins may be horizontal; in either case the centre of curvature of their points, at the places where those points bear in the grooved recesses of the rails, being at, or very near to, the centre of curvature of the lower part of my segmental bearing-piece, and of the cell in which it is lodged. In fig. 1, the cylindrical pins are shown detached, in order to explain the manner in which the pointed extremity applies into the grooved recess in the rails, so as to exert a bearing-down action thereon; and in the same fig. 1, a chissel-end is represented, as well as a conical point.

Fig. 5, sheet I., is a perspective view; and

Fig. 6, sheet II., is a transverse section of a chair for supporting the iron rails at intermediate distances between the extremities or junctions of their several lengths; it has only one cylindrical pin, 5, fitted through one of its cheeks, B, the opposite cheek, K, being a flat vertical surface, against which the flat side of the rail is pressed and held firm, by the keying up of the cylindrical pin, 5, so as to confine the rail laterally at the same time that the oblique action of the point of the cylindrical pin, 5, in the grooved recess in the rail, produces a bearing-down action, which confines the rail down upon my segmental bearing-piece, 4, which is applied in a cell at the bottom of the notch of the chair exactly the same as in the chair with two cylindrical pins, before described. The chairs are to be made of cast-iron; the sockets for the cylindrical pins, the mortices for their wedge-like keys, and the cells for my segmental bearing-pieces, being all formed in the casting, as well as the holes for the holding-down spikes. The wedge-like cross keys, the cylindrical pins, and the segmental bearing-pieces, are to be made of wrought-iron.

Having now described the nature of my said improvement, and the manner in which the same is to be performed I, the said Robert Stephenson the younger, do hereby declare that the new invention whereof the exclusive use is granted to me by the aforesaid letters patent, consists in the mode hereinbefore described of supporting the iron rails for edge railways upon a segmental bearing-piece, which is lodged in a suitable cell, at the bottom of the notch in each chair, the rail being confined downwards on such bearing-piece, by the same force of keying action, which also confines the rail laterally in the chair, and the action or pressure which produces such confinement, being applied at or very near to the centre of curvature of the said segmental bearing-piece, and of the cell wherein the same is lodged, in order that the supporting and confinement of the rails may not be disturbed or relaxed by a slight tilting or inclination of the chair in the direction of the length of the rails, as hereinbefore explained. And as to the mode hereinbefore described, of producing the requisite confinement of the rails in the chairs, by means of wedge-like cross keys and cylindrical pins applied in suitable sockets through the cheeks or sides of the chairs, and by forcing the pointed extremities of those pins into oblong grooved recesses in the rails, so as to exert an oblique bearing-down action on the rails, by the same force of keying, which produces the lateral confinement of the rails in the manner hereinbefore described; I wish it to be understood, that although the said mode of producing the requisite confinement was invented by me, yet the same was brought into use, (but without my segmental bearing-pieces for supporting the rails,) some months before the date of the said letters patent, wherefore I do not make claim to the exclusive use of the said mode, unless my segmental bearing-pieces are used in concert therewith, for supporting the iron rails of edge railways.—In witness whereof, &c.

Enrolled June 11, 1834.

Habits of Spiders.—M. Walckenaer related before the Entomological Society of France, the following curious fact, which is given on the authority of Mr. Spence. Having placed a large full grown spider, of the species *Epeira diadema*, on a cane planted upright in the

midst of a stream of waters, he saw it descend the cane several times, and remount when it had arrived at the surface of the water. Suddenly he altogether lost sight of it, but a few minutes afterwards, to his great astonishment, he perceived it quietly pursuing its own way on the other side of the stream. *Epeira* having spun two threads along the cane, had cut one of them, which, carried by the wind, had become attached to some object on the bank and so served the spider as a bridge across the water. Mr. Spence believes that spiders, when adult, always use similar means to cross water. M. le Pellitier de Saint Fargere also supported the opinion.—[L' Institute.]

CONVERSION OF SALT WATER INTO FRESH.—An important and completely successful experiment has been made by Mr. Wells, as to the conversion of sea water into a perfectly fresh and pure liquid, fit for every purpose of domestic use. The apparatus consists of a cast-iron cooking machine, about four feet in height, and the same in width, and contains ovens, roasting fires, pots, pans, kettles, &c., sufficient to dress a dinner for seventy or eighty men. The consumption of fuel is about two bushels in twenty-four hours; and by the internal application of the heated air, by means of tubes surrounding the various parts of the machine, roasting, boiling, and baking, are carried on with the utmost regularity and precision. Whilst the cooking is proceeding, the sea water is gradually supplied from a cask or tank, and passing into the interior of the machine, is there submitted to distillation. In its distilled state it flows into a pipe of cast iron, or of copper, tinned, which pipe is led over the bow of the vessel, and along the cut-water into the sea, and thence along the bottom of the vessel, till it returns into the hold, where a common stop-cock draws off the water. The grand improvement is the making the element in which the vessel floats the condenser of the altered liquid, which runs off at about the rate of a quart a minute, perfectly fit for drinking, washing, or any of the other purposes for which fresh water is employed. The patentee then filters it through charcoal, to restore the carbon which has been lost in the distilling. This invention will render the watering of ships unnecessary, and the room hitherto required to stow water may be used for goods.—[Literary Gazette.]

Would not the room required for the stowage of fuel to carry on the process be equal to that required for water?

[From the American Railroad Journal.]

A Short Account of the River Richlieu, from Lake Champlain to Sorel, in connection with the Chambly Canal.

The river Richlieu, which connects Lake Champlain with the St. Lawrence, is a fine stream, varying in breadth from five to sixteen hundred feet. Its precise length is not easily determined, since it is difficult to say where the lake ends; it may, however, be called about eighty miles long. From the lake to the village of St. John's, on the west bank, and that of St. Athanass, on the east, the distance is twenty-four miles, the whole of which, at all seasons, when not obstructed by ice, is navigable for vessels drawing six feet water.

The next twelve miles are chiefly rapid, making a fall of about seventy-eight feet, (in the whole distance,) into a very beautiful and natural basin, of about two and a half miles* in breadth and three long; on the west bank of which is situated the village of Chambly, distant from Montreal, in a direct line, about thirteen miles.

The remaining forty-two miles, (where the waters of the Richlieu and St. Lawrence join at the village of Sorel, or William Henry,) can, with a trifling expense, be made navigable for vessels of the same draft as the river will admit of above St. John's.

To overcome the difficulties occasioned by the twelve miles of rapid, the Chambly canal was projected; and as it has not appeared in your account of North American canals, it has probably never been heard of by you, I therefore take the liberty of sending you the following sketch to complete your list.

It is one of the largest class of canals, and though economy has been a point attended to, the work has still been carried on with due attention to beauty as well as strength.

The canal and harbor, connected, is twelve miles long, commencing at the village of St. John's, and ending at the Chambly basin. Its width is thirty-six feet at the bottom, sixty feet at top water line, and six feet water will be had in it at all times. The locks are of cut stone, one hundred and twenty feet by

* Can this be true?

twenty-four in the chamber. The bridges all swing or draw.

The canal commences by a weir of stone, sixteen hundred feet long, forming one side of a basin two hundred and fifty feet wide at the entrance, and nearly five hundred feet just within it, narrowing down to canal width, (60 feet,) at the lower end. One side of this basin is to be wharved up, and a street of sixty feet wide made, the materials for which are ready, and the work in progress.

At the end of this basin the rapid commences, and the banks are carried up fifteen feet high, to keep out floods. The guard lock, nine hundred feet from the entrance of the basin, is of stone, cut very smooth, and about the same dimensions as the other locks.

From this lock, three miles down, the bank falls with the river surface from fifteen to nine feet high, and from thence runs some distance across the river to an island near the west shore, forming a dyke, which, with a similar one at the foot of the island, about two miles and three quarters distant, gives, at a trifling expense, a natural canal of eight hundred feet wide, and twenty deep.

The canal from this to Chambly, except a half mile, made under a high bank in deep and rapid water, with a half mile of deep cutting through rock, follows a beautiful table and to Chambly, keeping from the river, and on the same level with St. John's.

Nine locks here come together within a mile, six of them are in a straight line, at short distances apart; the remaining three are combined. Four of these locks are built, and the materials for the rest are on hand.

Nearly four miles of this canal are made in the water, and part in very deep rapid water. A great deal of pumping has been necessary; the screw pump has been exclusively used; and the ease and comfort with which the excavation has been done, for long distances, six feet below the surface of the river, would surprize any person who has not seen it. The water work seemed but little more trouble than that on dry land, except the pumping. The banks, when made in the river, are well protected by a slope wall. It has been navigated, with four feet water, for ten miles of its length, during the fall; and nearly all the stones, put in the locks, have been brought to Chambly by the canal, having been reshipped from vessels which brought them from quarries thirty miles from the head of the canal.

The work was estimated, with locks of a smaller size, to cost $240,000; the actual cost will, however, fall short of $200,000, if nothing unforeseen occurs. The low prices of labor and stone-cutting, and the favorable nature of the ground, afford vast facilities for such an undertaking.

The Canadian French are equal to any masons and stone-cutters on the continent, for the beauty and excellence of their workmanship, and I think few are superior to them any-where.

The Chambly canal, when complete, will open a communication for large vessels from the ports on lake Champlain to all the line of the St. Lawrence, and thence to the sea. If the northern canal was larger, schooners from Quebec could, by an inland navigation, visit the Chesapeake.

The Richlieu, below Chambly, is to be improved by a lock and dam. Examinations and reports on it have been made by an engineer. Part of the money has been voted by the Assembly for constructing the works. More, however, is still required, and some alterations in the law relating to the river, before the commissioners can proceed with their improvements. H.

Undulating Railways. — Is not this subject of sufficient importance to induce the trial on a road two or three miles in length, by some of the railroad companies in this country?

Boston, 14th Dec., 1834.

To the Editor of the Railroad Journal:

Sir,—Your correspondent, Mr. Thomson, recalls our attention to the Undulating Railway System. Mr. T. states that Mr. Badnall's experiments would prove too much. I do not exactly perceive this. Mr. Badnall, I believe, asserts, and, as some think, proves, that, over a certain distance of road, a carriage can be moved with less expense of power, where the profile on that distance is undulating, than when it is perfectly straight; but he does not assert that it can be moved without any exertion of power.

A pendulum will vibrate equal distances on either side of a vertical line drawn from its axis. A carriage, on an undulation, will exhibit the same result, minus the friction; but this friction may be more than overcome by the action of the accompanying engine, both during its ascent and descent of the two sides of the undulation. And, if the power of an engine were unlimited, it would be easy to conceive how the velocity of a carriage would be accelerated over a series of undulations progressively, *ad infinitum;* but as there is a limit to the power of the engine — a velocity when it will become of no effect—so there is a maximum of speed or effect in the system. A progressive additional velocity, it is easy to perceive, could only be required by a capability in the machine of the exertion of a

progressive additional power. When the same has become of non-effect, or, rather, when its effect is merely sufficient to counterbalance the retardation caused by friction, the speed of the whole machine must have attained its limit. I say thus much on behalf of Mr. B.'s experiments, and not in behalf of his system, the theory of which, I am free to say, I do not precisely comprehend; but, admitting it to be true—admitting Mr. B.'s theory to be perfectly correct—is it available in practice? Is it safe to admit, at any time, of a speed of more than 30 miles an hour; and is it, at any time, advisable to allow of more than 20? Would we not prefer a *sufficient* road, over the whole extent of which we had an entire control, to a more perfect one, over which, when once in motion, we must necessarily be carried forward, (without power of stoppage, consistent with the benefits in dispute,) and where we can only command certain points, viz., the tops of the undulations? And, finally, is it at all certain that the expense of grading a series of undulations so as to conform correctly to the theory, would not be equal to the present antiquated method, which, as it does not *insist* on undulations, should be able to conform fully as nearly to the natural surface?

Every individual railroad may be considered as an individual piece of machinery. Should any accident occur, we want to have the power to remedy it as quickly as possible; should any car of a train get off the road, we want to stop that train immediately; should any wheel break, or axle bend, we want to throw out the damaged waggon; should there be any unexpected obstacle on the road, we want to be able to "pull up" till it is removed. But, if a train were moving at full speed down one of Mr. B.'s undulations, under such circumstances, blowing, and puffing, and straining, to acquire power for the ascent, the destruction would be tremendous. Wo to the unhappy passengers who might form part of it! I certainly agree with Mr. Cheverton—some of whose very excellent letters you have quoted from the London Mechanics' Magazine; that, viewing it practically, the system is very replete with absurdity. I have not time to say more.

Very respectfully, S. D.

Vicksburg Railroad.—We have been informed that about four hundred thousand dollars have been subscribed in the town of Vicksburg, to the railroad bank. A gentleman just from Clinton informs us, that *two hundred thousand* have been subscribed at that place, and we feel pretty confident that more than one hundred thousand dollars will be subscribed in this. Before the bank can go into operation, the charter requires that five hundred thousand dollars must be subscribed, and one hundred thousand paid in, so there is a very fair prospect of the bank's beginning operations in a very short period, and of the railroad from Vicksburg by Clinton, to the seat of government, being at least commenced.

Our neighbors of Natchez also are beginning to see the importance to them of a railroad to the interior of the state. They have a port of entry, and require some mode of conveyance for cotton to their wharves. Delegates have been appointed from our town to a railroad convention soon to convene in Copiah county, for the purpose of considering the propriety of constructing a road from Natchez to the interior, and we have but little doubt the work will be accomplished. We are pleased to see such a spirit abroad in the land.—[Mississippian.]

Who was the Inventor of Steam Navigation?—In the Saturday Magazine, last volume, there was an article on the invention of steam navigation, in which the honor of this great discovery was ascribed to Henry Bell. The superior claims of William Symington having been since brought before the Committee of the Society for Promoting Christian Knowledge, under whose superintendence the "Saturday Magazine" is published, they have just published the following very handsome and satisfactory correction of the error they had committed: "We have received a pamphlet, entitled 'A Brief Narrative: proving the Right of the late William Symington, Civil Engineer, to be considered the Inventor of Steam Land-Carriage Locomotion, and also of Steam Navigation.' From the statements of the author, Mr. Robert Bowie, and the documents he has produced, it is evident that Henry Bell availed himself of his knowledge of Mr. Symington's plans, and of the unauthorised inspection of the models of his apparatus, in constructing the boats upon which his unfair claims to the invention were founded. Mr. John Kay, of Rochdale, has also written under the impression that Mr. Bell was present when he, Mr. Kay, suggested the idea of working small boats by hand machinery, and large vessels by steam engines. Mr. Kay is, however, widely mistaken, as he states the conversation, to which he alludes, to have taken place at Liverpool, in 1796 or 1797, and Mr. Symington had actually worked a boat by steam machinery in 1758."